Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)	
	)	
Office of Engineering and Technology	)	ET Docket No. 16-191
Announces Technological Advisory	)	
Council (TAC) Noise Floor Technical	)	
Inquiry	)	

COMMENTS OF DTS, INC.

DTS, Inc. ("DTS"), by its counsel, hereby submits these comments in response to the Technical Advisory Council (TAC) Noise Floor Technical Inquiry.[1] As is explained in greater detail below, DTS believes the spectrum noise floor is a significant issue for radio services in the AM and FM bands, and the introduction of electronics and other devices in recent decades has dramatically increased that noise floor.

1. Background

In October 2015, DTS acquired iBiquity Digital Corporation, the inventor of the HD Radio™ system for digital AM and FM broadcasting. The HD Radio system allows AM and FM stations to introduce digital broadcasting in the existing broadcasting bands without the allocation of additional spectrum. HD Radio technology inserts digital carriers on either side of the existing analog AM and FM signal without causing harmful interference to the analog broadcast. AM broadcasts are upgraded to FM quality, and FM stations can offer CD-quality broadcasts. In addition to enabling higher audio quality, HD Radio technology improves resistance to multipath interference and allows FM broadcasters to offer new, multicast audio channels and enhanced data

[1] *Office of Engineering and Technology Announces Technical Advisory Council (TAC) Noise Floor Technical Inquiry*, ET Docket No. 16-191, Public Notice DA 16-676 (June 15, 2016).

services such as album art, traffic updates and weather and news alerts. These improvements to AM and FM transform the user experience and allow broadcasters to better compete with satellite radio, streaming and other forms of digital news and entertainment.

Today there are more than 2,300 radio stations in the United States that have converted to HD Radio broadcasting, and HD Radio broadcasters have introduced more than 1,800 new multicast channels. Every major automobile brand offers digital receivers in its vehicles, and a new vehicle is sold with HD Radio technology every 3.5 seconds. Digital broadcasts are available in every major market in the United States. Outside the United States, HD Radio technology is the approved standard for digital broadcasting in Mexico and the Philippines and is in use on an experimental basis in several major markets in Canada.

As the inventor of HD Radio technology, DTS has spent more than twenty years studying the interference environment in the AM and FM bands. The HD Radio system was designed to operate in the challenging environment of the AM and FM bands taking into account the noise floor and the impact of that interference on digital broadcasts. As part of that effort, DTS has conducted formal and informal analyses of the noise environment for AM and FM broadcasts in a variety of environments. For example, DTS conducted a multiyear laboratory and field test program analyzing HD Radio technology in the late 1990s and early 2000s in conjunction with the National Radio Systems Committee. Since the commercial introduction of HD Radio technology in 2004, DTS has worked with broadcasters throughout the country to study the coverage of HD Radio broadcasts as well as the compatibility of HD Radio broadcasts with existing analog broadcasting. In many cases those tests and studies have found a significant impact from the level of ambient noise and the overall noise floor. Due to its focus on AM and FM broadcasting, DTS will limit its comments to the impact of the noise floor on radio services in those bands.

2. Is There a Noise Problem?

DTS's long term experience with AM and FM broadcasting consistently has demonstrated there is a significant noise problem that impacts radio services in these bands. The sources of that noise are varied and can have different impacts depending on the listening environment.

For AM and FM radio listeners, noise problems originate from the cumulative impact of all the radio stations in the broadcasting bands, from other components in radio receivers that emit noise and from many other devices found in homes, cars and elsewhere. Although AM and FM broadcasts have always been subject to atmospheric conditions and natural sources of noise, there are an increasing number of man-made sources of noise that impact radio. Overhead power lines and in-house wiring have consistently been a significant source of noise, particularly for AM radio reception. More recently, devices with a switching power supply, such as many florescent light bulbs and lights with dimmer switches, have become a dominant source of noise impacting radio broadcasts. Similarly, as computer clocks have increased over the years, more electronics designs have fundamental clock noise in the FM band. The proliferation of computers, smart phones and tablets as well as the conversion to florescent and LED lighting has increased noise sources in homes. In cars, the use of electronic control units with clocking and memory signals throughout the vehicle as well as the introduction of LED lighting has increased the noise impact on radio reception. The impact is not noticeable to consumers because there is no signature sound that the listener hears. Instead, reception simply is lost as noise overwhelms the radio's ability to receive the desired broadcast.

Most of these sources of noise would be classified as incidental radiators. As a result, they have largely escaped regulatory oversight even as their impact on radio reception has grown.

3. Where Does the Problem Exist?

The noise floor impact presents greater challenges for AM radio but still has a significant impact on FM reception. The proliferation of electronics indoors has made indoor reception much more problematic than outdoor reception, but the growing use of electronics in cars now impacts in-car reception. The growth of man-made noise also has created a dynamic where the urban noise floor greatly exceeds the noise floor in rural areas.

In November 2001, the National Radio Systems Committee adopted a noise report designated NRSC-R200.[2] That study adopted the findings of iBiquity Digital Corporation that the cumulative impact of all the radio stations in the broadcasting bands created an outdoor noise floor impacting radio reception. The noise study concluded the noise levels in the FM band ranged from 15 dBu (30,000 K) to 25 dBu (300,000 K).[3] Based on these types of findings, DTS routinely advises its licensees to take noise into account in the design of radio receivers:

> Ambient noise in the FM broadcast band could be as low as 3000 kelvin in rural areas (primarily cosmic in origin), and as high as 200,000 kelvin in urban areas (primarily due to manmade sources). Three thousand (3000) kelvin ambient noise at the antenna is equivalent to (same noise power as) a 10-dB noise figure Tuner. It is therefore unnecessary to achieve a noise figure less than about 10 dB, since ambient noise would begin to dominate.[4]

Although this study did not analyze indoor or in-vehicle noise interference, the study documents the high level of noise observed and anticipated in a variety of environments. The more problematic indoor environment was further documented in a 2008 study of indoor reception CBS Radio conducted. That study found that "[i]n 75% of the buildings tested, the analog reception

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[2] National Radio Systems Committee, NRSC-R200, NRSC Noise Report (Nov. 2001), available at http://www.nrscstandards.org/reports.asp.

[3] *Id*. at 9.

[4] IBOC Receiver System Functional Analysis Description (SFAD), iBiquity Digital Corporation System Document No. RX_SFAD_1003, Rev. 03.02 (Oct. 18, 2011) at 6.

was described as non-existent, noisy or poor."[5] Although the building structure itself is responsible for some of the shielding of the radio signal, the existence of power lines and electronics in the buildings contributed to a noise floor that reduced radio reception.

The introduction of tremendous numbers of new electronic devices and new light bulbs since these studies were conducted means noise levels can be expected to be even higher today. And higher noise levels translate into an even greater reduction in radio reception.

4. How Should a Noise Study Be Performed?

DTS believes any new noise studies should focus on the impact of new devices that have become a part of everyday life and add new sources of noise. As a baseline, simple noise measurements can be conducted in rural areas away from known sources of noise and compared with noise measurements in urban areas where noise levels are known to be higher. Also, indoor testing should be conducted in both areas to determine whether the introduction of household electronics and lighting creates so much noise that it eliminates the differential between rural and urban areas seen in outdoor testing.

For AM and FM radio, it is important that any studies include testing of the in-vehicle noise environment. Car testing should consider the noise environment both with and without the antenna system. In addition, any in-vehicle study should consider the impact of power windows and other power systems in the car as well as the impact of charging electronics such as cell phones using the car's 12-volt adaptor.

5. Conclusion.

DTS supports the efforts of the TAC to quantify and study the impact of noise on radio reception. The impact of incidental radiators has been significant for AM and FM radio listeners

[5] Letter from Steven A. Lerman to Ms. Marlene H. Dortch in Docket 99-325 dated June 10, 2008 at 7.

over the past decade. The introduction of new electronics in the home and car has the potential to cause further deterioration to the radio reception environment. In particular, the introduction of advanced electronics associated with smart and autonomous vehicles could greatly increase noise. Autonomous vehicles use a large number of sensors, radar and other transmissions to sense other vehicles, people and objects as well as to allow for direct communication between autonomous vehicles. All these enhancements have the potential to introduce new noise that will impair radio service. DTS encourages the TAC to analyze these trends and sources of noise and to propose for FCC consideration enhancements to the Commission's oversight of incidental radiators to reduce the impact of noise on radio reception.

Respectfully submitted,

/s/

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Dated: August 11, 2016